PET CT scan in Rheumatology

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PET (Positron Emission Tomography) is a non-invasive diagnostic imaging technique used to detect the metabolic activity of cells.

It was first introduced in 1970 to assess the function of brain cells.
all emits gamma rays

- Scintigraphy - technitium 99 phosphates – bone, 2D. Only lesion more than a centimetre

- SPECT – Technitium, Thallium, MUGA - 3D (less than 1 cm), cardiac, parathyroid.

- PET - 18F FDG, much higher spatial resolution. gamma photons in two directions. Resolution upto 5 mms.
how is it done?

- Patient should be fasted and no diabetic tablets or insulin should be taken that day.

- 18F FDG made my cyclotron in the same centre is injected intravenously.

- Patient has to sit quiet and without moving for about 30 minutes.

- Gamma ray acquisition is done for about 30-40 minutes.

- Plenty of water to be taken after the procedure.
Disadvantages of PET

- short acting
- expensive
- diabetic patients
- rarely allergic reactions
• MRI usually produces images within a limited field of view, and US (ultrasound) is limited by variability and labor intensity.

• In addition, in the presence of inflammation, both techniques can visualize indirect inflammatory signs such as increased tissue water content and hyperperfusion but PET provides direct inflammatory signs.
The usefulness of PET/CT imaging in the assessment of the severity of the disease

- Recently, Matsui and colleagues reported FDG uptake in the area in which inflammatory cell infiltration and synovial cell hyperplasia were visible in an arthritis model.

- The FDG uptake by inflammatory tissue, such as arthritis lesions, seems to reflect the inflammatory activity accurately.

- Such studies have strongly encouraged the clinical application of FDG-PET/CT for rheumatic diseases.
Beckers and colleagues reported **sensitivities of up to 90%** in a study evaluating 356 joints of 21 patients with established RA by using FDG-PET.

However, despite a greater number of FDG-positive joints in RA than in osteoarthritis patients, absolute values for tracer uptake do not differ between these two conditions.

Whole-body PET may aid in differentiation between RA and other inflammatory joint diseases.

PET may allow detection of subclinical disease activity also.

Besides its ability to detect and monitor subclinical disease, PET may have prognostic power.
Spondyloarthritis
Spondyloarthritis

• PET/CT scans of the shoulder, hip, and knee joints revealed that FDG accumulates at the entheses in SpA (spondyloarthritis) and in the synovium in patients with RA.

• Lumbar spinous processes and ischial tuberosities appeared more frequently via PET/CT than MRI in patients with SpA.

• PET/CT represents an alternative modality to identifying enthesitis and will likely contribute to the early diagnosis of SpA.
• Blockmans and colleagues analyzed FDG-PET changes in patients with PMR, analyzed the precise distribution of lesions via PET/CT and evaluated differences in FDG accumulation between PMR and similar diseases.

• Positive results at two or more of these sites were highly sensitive (85.7%) and specific (88.2%) for the diagnosis of PMR.
Polymyalgia Rheumatica

(A)

(B)

(C)

(D)

Active PMR → Remission
Adult Onset Still’s disease
Adult-onset Still’s disease

- FDG-PET/CT for diagnosis and disease evaluation of AOSD in **seven patients** with AOSD and reviewing the literature on seven previous reports of PET/CT in patients with AOSD.

- FDG accumulation was positive mainly in the bone marrow (100%), spleen (90.9%), lymph nodes (80.0%), and joints (75.0%).

- Follow-up PET/CT showed diminished FDG accumulation, as measured by SUVmax, in the bone marrow, spleen, and lymph nodes.

- In conclusion, **FDG-PET/CT is useful for long-term assessment of AOSD activity in individual patients.**

- However, PET/CT findings alone are not sufficient to make a differential diagnosis of AOSD versus malignant lymphoma.
Relapsing Polychondritis
Relapsing polychondritis

• PET reveals nasal chondritis despite an absence of nasal changes upon physical examination.

• FDG-PET/CT is a potentially powerful tool for the early diagnosis of RPC, especially in patients with affected organs that are difficult to biopsy.

• This modality also facilitates the evaluation of extent of disease and disease activity during treatment.
**IgG4-related disease**

- IgG4-related disease (IgG4-RD) is a systemic disorder associated with lesions characterized by mass formation in multiple specific organs.

- The combination of lesions on FDG-PET/CT may strongly suggest or support the diagnosis of IgG-4RD.

- Shigekawa and colleagues noted that the FDGPET pattern at baseline, including extra-abdominal lymph nodes or salivary glands (or both) and the involvement of the eyes and biliary ducts.

- Ozaki and colleagues also found that **FDG uptake by hilar lymph nodes was significantly more frequent in AIP than in pancreatic cancer.**
IgG4-related disease

• Ebbo and colleagues evaluated FDG-PET/CT for disease staging and treatment evaluation in 46 FDG-PET/CT images from 21 patients with IgG4-RD.

• In most cases, FDG-PET/CT was more sensitive than conventional imaging to detect organ involvement, especially in the arteries, salivary glands, and lymph nodes.

• In a few cases, FDG-PET/CT failed to identify small or contiguous lesions in the brain or kidneys.
Large vessel vasculitis
Large-vessel vasculitis

- From a **systematic review** on FDG-PET/CT in patients with LVV, Treglia and colleagues drew several conclusions.

- First, FDG-PET/CT appears to be useful in early diagnosis and in the assessment of disease activity and extent.

- Second, the correlation between FDG-PET findings and serological inflammatory markers as well as the usefulness of FDG-PET/CT in evaluating treatment response require further investigation.

- FDG-PET/CT appears to be superior to conventional imaging methods, such as US or MRI, in the diagnosis of LVV but **not in predicting relapse or evaluating vascular complications such as stricture or aneurysm.**
Wegener’s granulomatosis (GPA)

- In the first evaluation of FDG-PET/CT imaging for the diagnosis and monitoring of WG, when retrospectively analyzed 13 FDG-PET/CT images obtained from eight patients.

- WG lesions of the upper respiratory tract and lung were more clearly detected by FDG-PET/CT fusion imaging than by non-enhanced CT alone.
Owada and colleagues examined whether FDG-PET can detect myositis or extramuscular lesions in patients with polymyositis (PM) and dermatomyositis (DM) and observed increased FDG uptake in muscle in 33% of patients.

FDG-PET did detect neoplasms in patients with associated malignancy, which accounted for 38.9% of patients with interstitial lung disease.

Thus, FDG-PET imaging appears to have limited usefulness for the evaluation of myositis in patients with PM and DM because of its low sensitivity.
Spondylodiscitis – non-specific but useful in monitoring treatment response
Sarcoidosis

Very useful in cardiac sarcoidosis for diagnosis and treatment response.
other potential uses

- osteomyelitis (not in prosthetic or post-operative)
- Inflammatory bowel disease (mainly in children)
- Thyroditis (not useful)
Future of PET

Immuno PET
PET /MR
The potential applications of immuno-PET

- The development of non-invasive imaging techniques using monoclonal antibodies (mAbs) is a quickly evolving field.

- Immuno-PET uses positron-emitting isotopes to track the localization of mAbs with excellent image quality.

- Immuno-PET is expected to become an option as a non-invasive diagnostic tool providing ‘comprehensive immunohistochemical staining in vivo’.

- Therefore, immuno-PET has enormous potential for diagnosing rheumatic disease and evaluating its activity in the presence of disease-specific mAbs.
Conclusions

• Large Vessel Vasculitis such as Takayasu’s, relapsing polychondritis, cardiac sarcoidosis, IgG4 diseases and sometimes in SpA – very useful for diagnosis and superior to any other modality currently available.

• RA, AOSD and PMR useful for diagnosis but not sure is superior to other existing imaging/clinical modalities.

• Polymyositis, thyroiditis, peri-prosthetic osteomyelitis – not useful for diagnosis
• Immunot PET targeting specific antibodies/cell receptor is the future.
Thank you!